

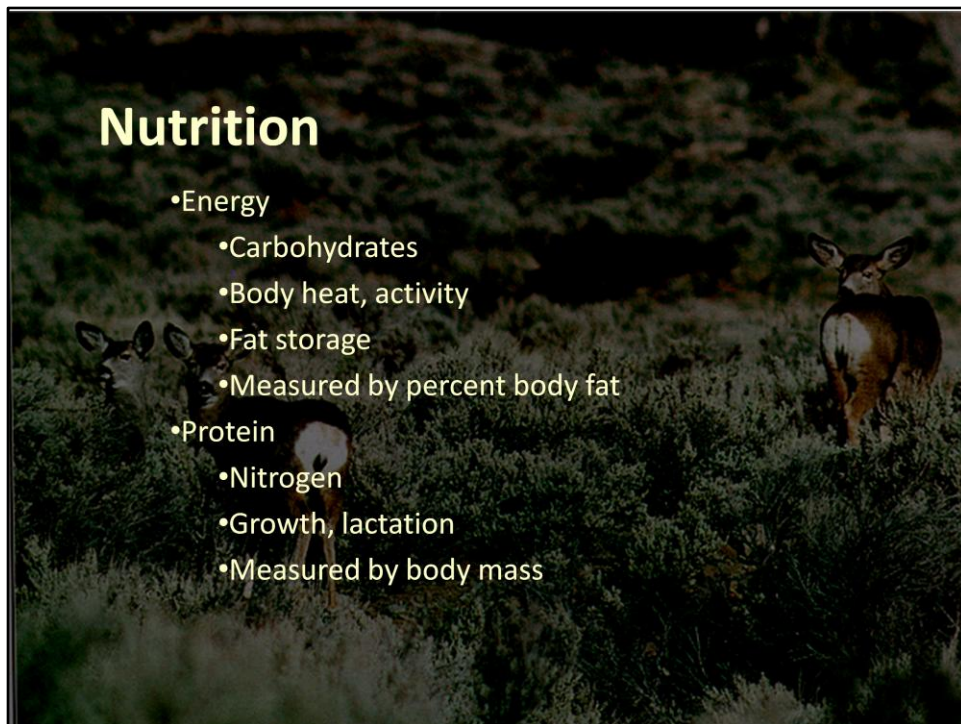


This presentation will include a brief “Habitat 101” as well as a summary of some of the more significant findings from a habitat evaluation of the Owl Creek/Meeteetse herd unit done in the e

What is mule deer habitat?

- The resources and conditions present in an area that enable *reproduction* and *maintenance* of mule deer
- Resources: food, water, cover and space

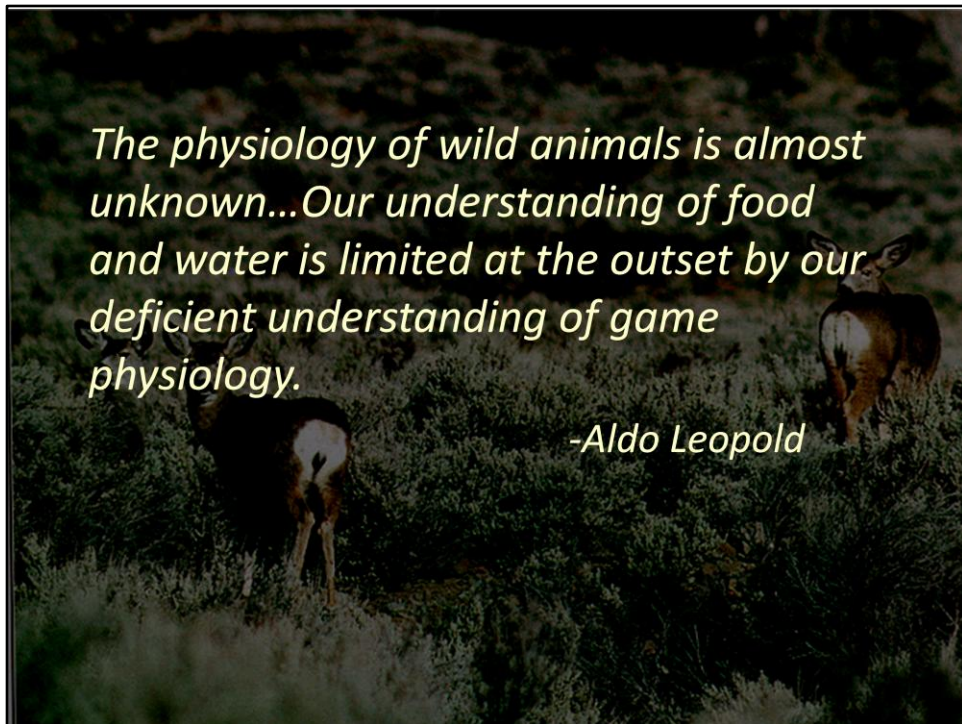
Key words here are reproduction and maintenance—the level deer are able to do both of these things, especially the reproduction, is an indicator of how healthy the habitat is



I don't want to minimize the importance of water, cover and space, but reproduction and maintenance is largely a function of what kind of body condition deer are in. The most common factor that typically drives body condition is nutrition. Nutrition of any animal is based mostly on these two things: Energy and Protein.

Energy is produced by metabolizing carbohydrates. Energy is used during any activity of an animal including merely breathing. If rate of intake of energy (in the form of carbohydrates) exceeds the rate of metabolism, energy is stored in the form of fat reserves in various areas of the body. Conversely if rate of intake is lower than the rate of metabolism, fat reserves are used for the required energy. An index of energy reserves is easily obtained by measuring body fat (expressed as a percent of body weight). Deer are able to store about 24% of their body mass as fat (but rarely do in natural settings).

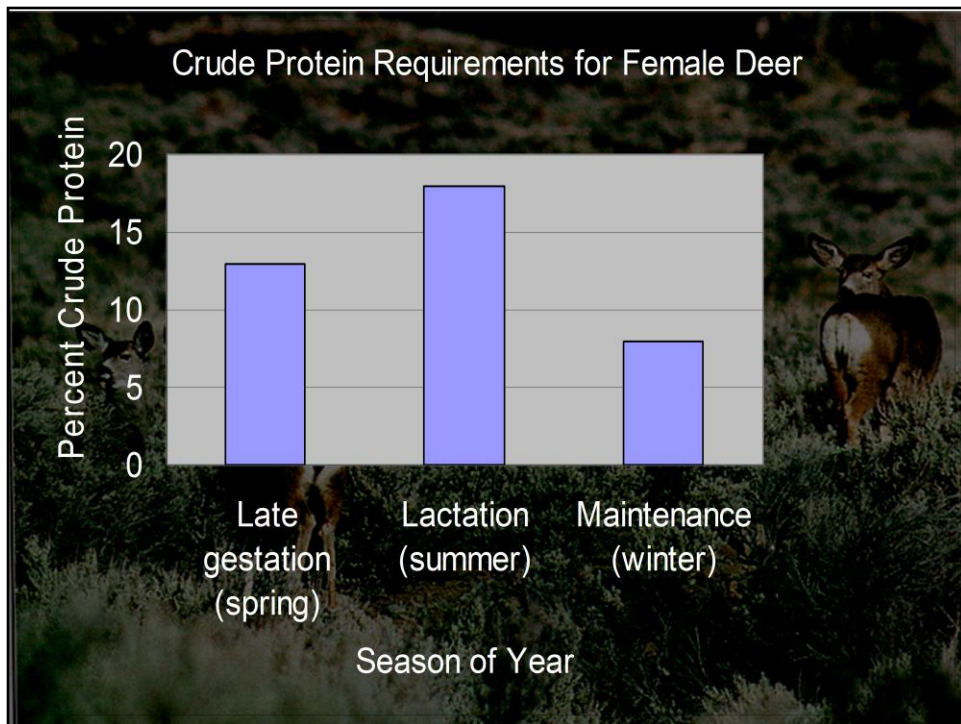
Protein is obtained either by ingesting proteins from plants or they are synthesized by microorganisms gut using nitrogen from plants in the diet. Protein is used in growth of body tissue and is especially important in producing milk. Body mass (the total weight of the animal) is a good indicator of adequate protein in the diet.



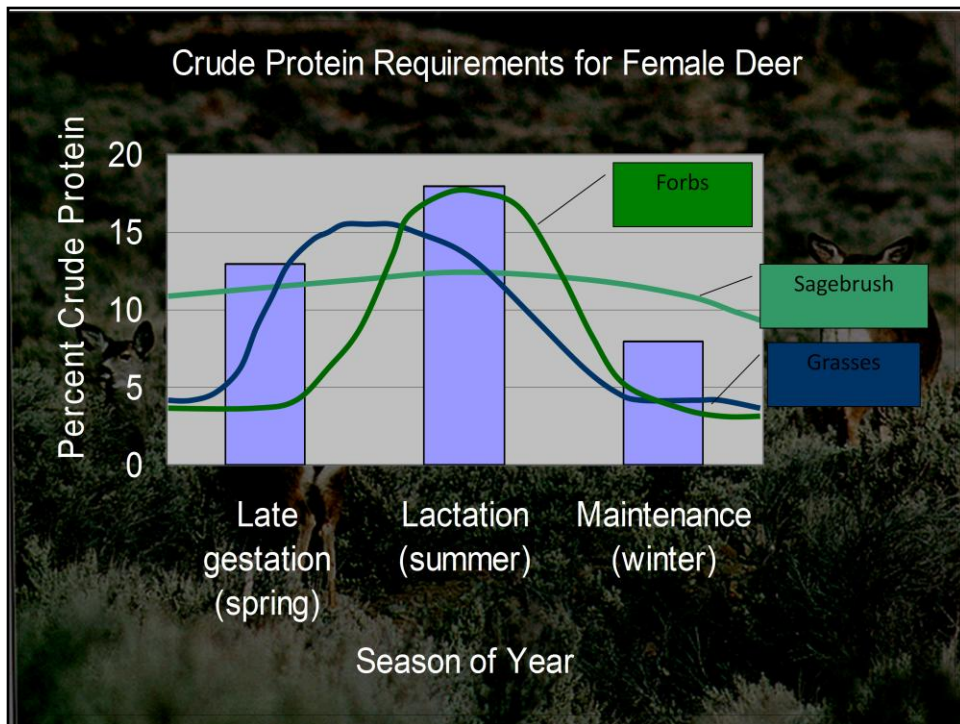
The physiology of wild animals is almost unknown...Our understanding of food and water is limited at the outset by our deficient understanding of game physiology.

-Aldo Leopold

This quote from the “Father of wildlife management” was given over 80 years ago. Although we have gained a lot of understanding of wild ungulates, mule deer nutrition is still not well understood, mostly because mule deer are not well adapted to the type of confinement (pens) necessary to conduct studies on nutrition.



We'll look at the relationship between an individual deer and her habitat. When we are speaking of nutrition, we are mainly concerned here with females as their contribution to reproduction and juvenile survival is much more effected by nutrition. This graph shows seasonal crude protein (nitrogen content in the diet) requirements for a reproducing female. As you can see the demands of lactation are very high. Quantitative information on energy requirements are largely lacking, but relative importance between seasons is similar to that of protein.



The right levels of quantity and quality of forage needs to be available throughout the season for the doe to remain healthy. Forage can be classified as grasses, forbs and shrubs (sagebrush is the primary shrub species in the OCM herd unit). As seen from this graph, grasses (after spring greenup) are the only food item that meets or exceeds protein requirements during late gestation (just before fawning); forbs are the only food item that comes close to meeting requirements during lactation; and sagebrush is the only item that meets requirements during winter. There is some uncertainty whether deer can actually digest the crude protein available in sagebrush during the winter. Typically deer do not ingest enough protein or energy in winter to meet their demands and they lose weight. This is why high nutrition during late summer and early fall is critical for building fat reserves to be used in the winter

Unlike elk, cattle and other “generalist” ungulates, deer have relatively small digestive system capacity in relation to their body size and a relatively short time period where food is digested. This means they must ingest food items with very high nutrient levels. For this reason, deer are very selective feeders and will select only the choicest parts of plants. As an example, if drought conditions cause a failure or early dessication of forbs in a given summer, the nutritional needs of a doe may not be met. She may fill her gut up with food but because that food doesn’t meet her requirements, she may not produce good milk. Even though deer are very selective foragers, if the nutrition in even the most choice parts of plants isn’t adequate, unlimited amounts of plants material will not meet her requirements because she is not able to digest it fast enough. With any kind of herbaceous plant, the “green-ness” is an indicator of high nutrition: green is good!

Effects of poor nutrition

(inadequate protein and energy in the diet)

- Late Summer 2014: Doe recovers from high demands of lactation
- November 2014: Doe is bred
- Winter 2014/2015: Gestation
- June 2015: Fawn is born
- Summer/Fall 2015: Fawn increases in body size and stores fat
- Winter: Fawn survives winter

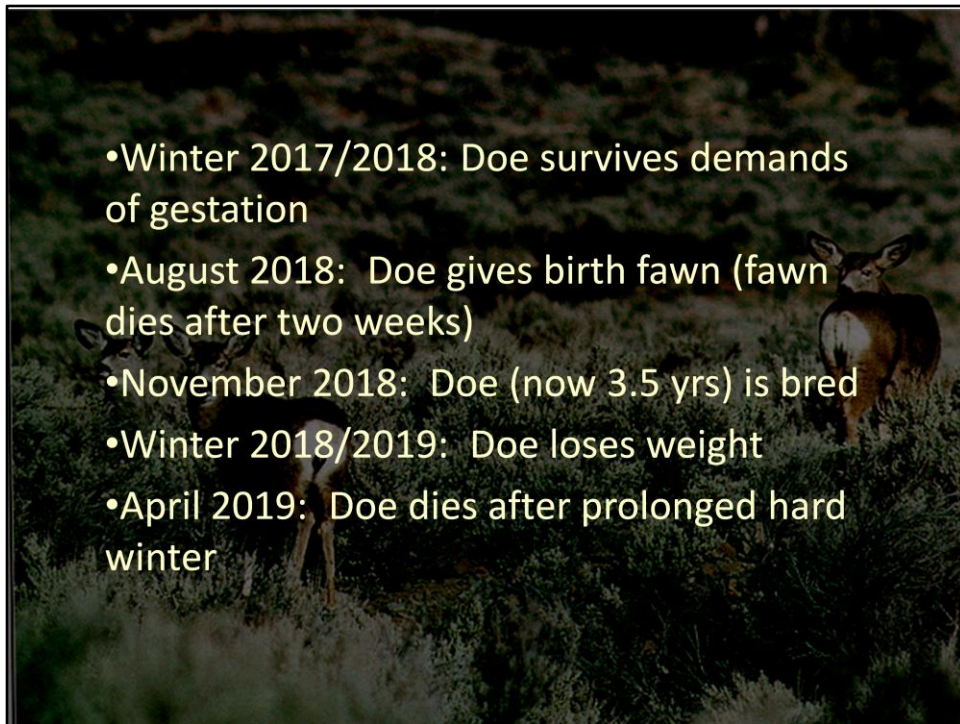
We are going to take a look at the life of an individual female mule deer to examine the effects of poor nutrition. We will start with that deer's mother in the summer of 2014

- Late Summer 2014: Our deer's mother recovers from high demands of lactation. Because of poor nutrition (especially energy) in her summer/early fall habitat, she is unable to store much body fat.
- November 2014: Doe is bred. Unlike elk and other ungulates, pregnancy rates in mule deer do not vary much with nutritional status. They usually get pregnant.
- Winter 2014/2015: After losing all of her stored body fat, our deer's mother survives the winter but is extremely nutritionally stressed.
- June 2015: This nutritional stress causes not only affected her body weight but also her fawn, which is born much underweight. Birth weights are probably the most important predictor of whether a fawn will survive its first year.
- Summer/Fall 2015: Our fawn, in addition to being born small and is unable to grow as much as she needs to before the onset of winter because of poor milk production from her mother and poor feed once she is weaned. Survivorship of fawns during the winter is largely a function of body weight.
- Winter: Although our fawn is underweight she managed to survive a light winter.



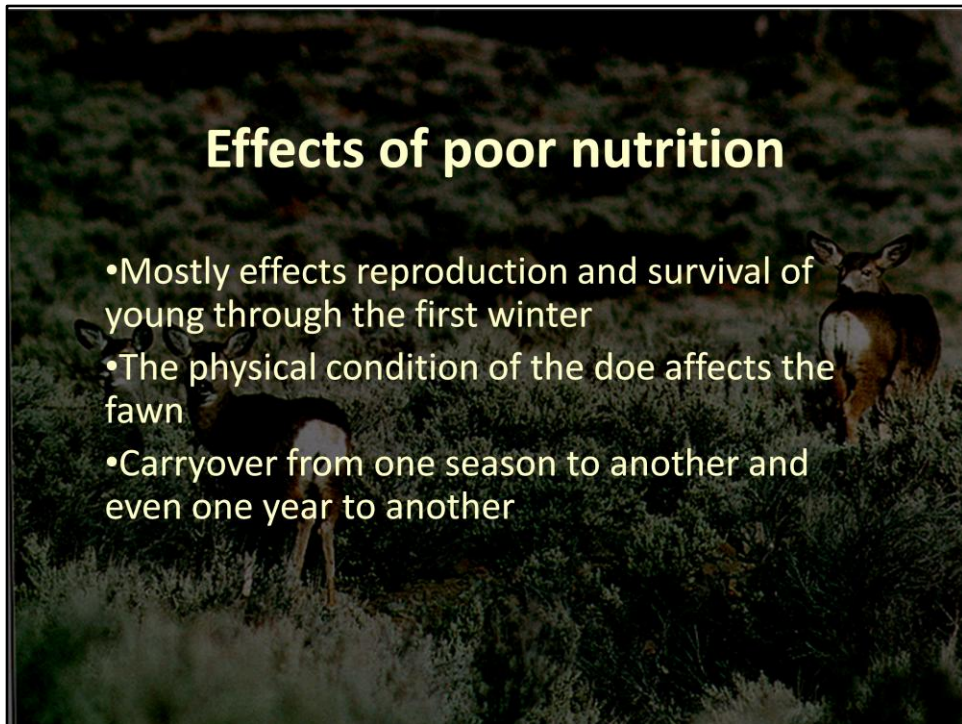
- Spring 2016: Fawn recovers from winter
- Summer/Early Fall 2015: Yearling increases body mass and stores fat
- November 2016: Yearling fails to breed
- Winter 2016/2017: Yearling survives winter
- Summer/Early Fall 2017: Doe increases body mass and stores fat
- December 2017: Doe is bred (at 2.5 yrs)

- Spring 2016: Early spring green-up comes just in time for our fawn.
- Summer/Early Fall 2015: Our deer, now a yearling, tries to put on body fat, but droughty conditions produce few forbs on the same summer range that her mother has used the year before.
- November 2016: Our yearling which is still undersize—a condition still partially a result of her small birth weight—fails to breed. Sexual maturity is largely a function of body size. Yearlings in good condition are usually bred.
- Winter 2016/2017: Our yearling goes into winter in poor condition, but luckily for her it is another mild, open winter.
- Summer/Early Fall 2017: Our doe summers in the same area and again does not find forage of high enough quality to put on sufficient fat reserves.
- December 2017: Our 2 ½ year-old doe is bred late (she is barely sexually mature, being still underweight for her age).



- Winter 2017/2018: Doe survives demands of gestation
- August 2018: Doe gives birth fawn (fawn dies after two weeks)
- November 2018: Doe (now 3.5 yrs) is bred
- Winter 2018/2019: Doe loses weight
- April 2019: Doe dies after prolonged hard winter

- Winter 2017/2018: Our doe survives demands of gestation but both she and her fawn suffer from malnutrition
- July 2018: Our doe's gestation period is delayed by several weeks to give more time for the fetus to grow (not uncommon in mule deer). That with a late breeding results in her giving birth in August. The fawn is still only half of a normal body weight and dies after two weeks.
- November 2018: Doe (now 3.5 yrs) is bred after a summer in which, even though she lost her fawn early, she never really recovered from the demands of birthing and lactation and, again, went into the winter in very poor condition.
- Winter 2018/2019: Doe loses what little body fat reserves she had in mid-winter and begins metabolizing protein (muscle tissue). Protein has half of the energy value per unit of weight as fat.
- April 2019: After a severe April storm with low temperatures and heavy snow cover that persists for weeks, our doe perishes with her twin fetus.



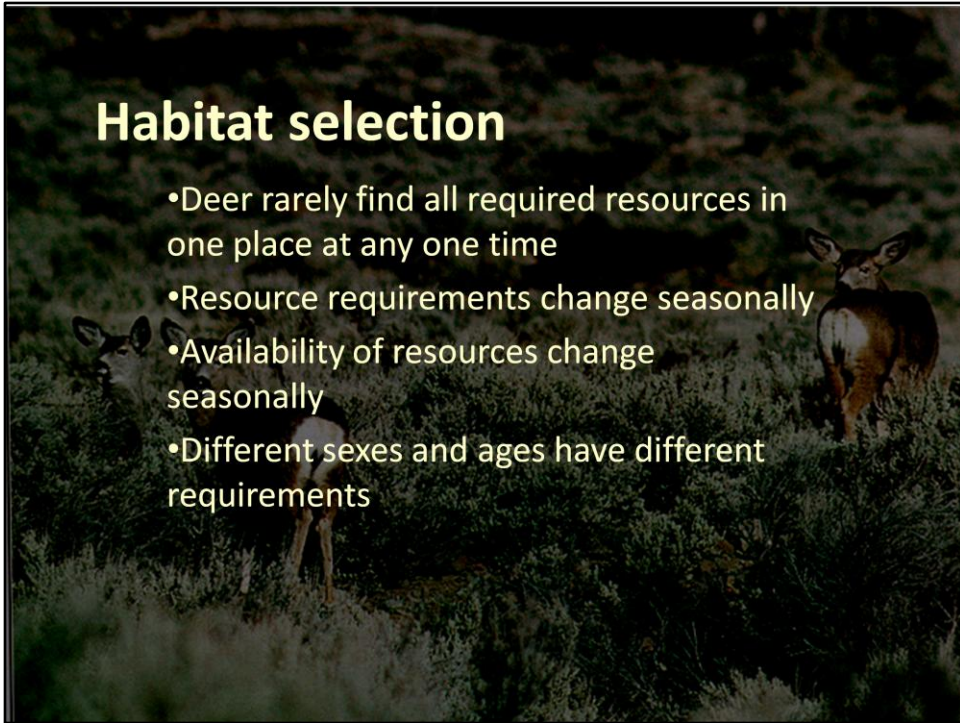
Effects of poor nutrition

- Mostly effects reproduction and survival of young through the first winter
- The physical condition of the doe affects the fawn
- Carryover from one season to another and even one year to another

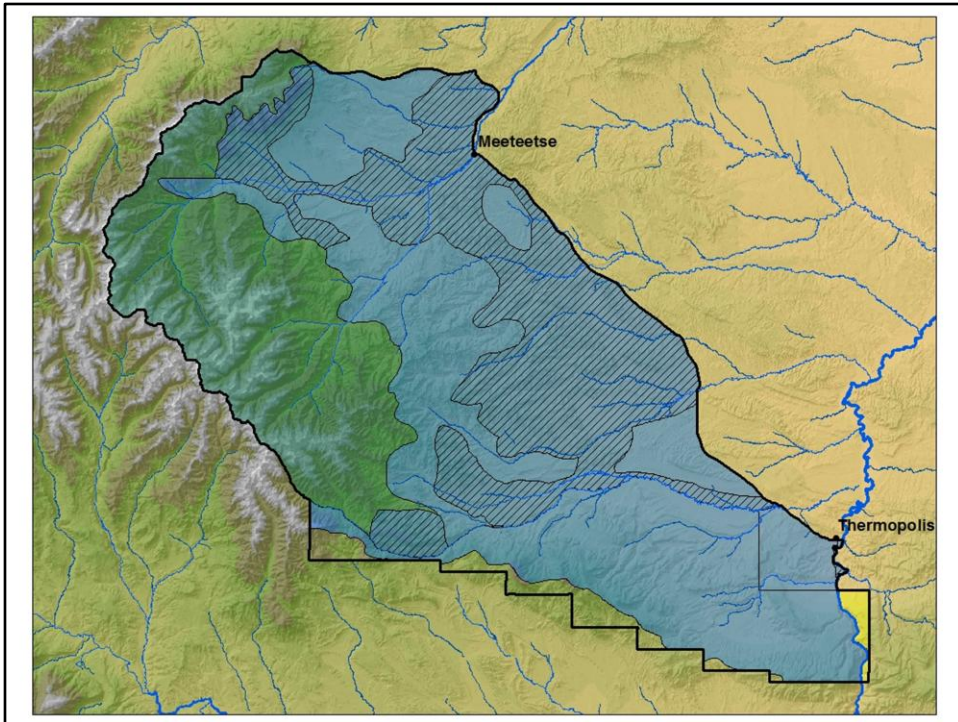
A summary of the effects of poor nutrition

Habitat selection

- Deer rarely find all required resources in one place at any one time
- Resource requirements change seasonally
- Availability of resources change seasonally
- Different sexes and ages have different requirements



Mule deer select habitats to attempt to fulfill nutritional and other requirements.



At a very broad scale we delineate habitat selection during different seasons by what we call our seasonal ranges. This is mostly a function of where we find deer in the winter which is related to low snow cover. Summer range is shown in green and winter range in blue with the hashed area being crucial winter range.



Reproductive Habitat

- High quality forage for reproducing females during late spring, summer and fall
- Maintain high nutrition for fawning and lactation
- Recovery of body condition prior to breeding season and winter

Maintenance Habitat

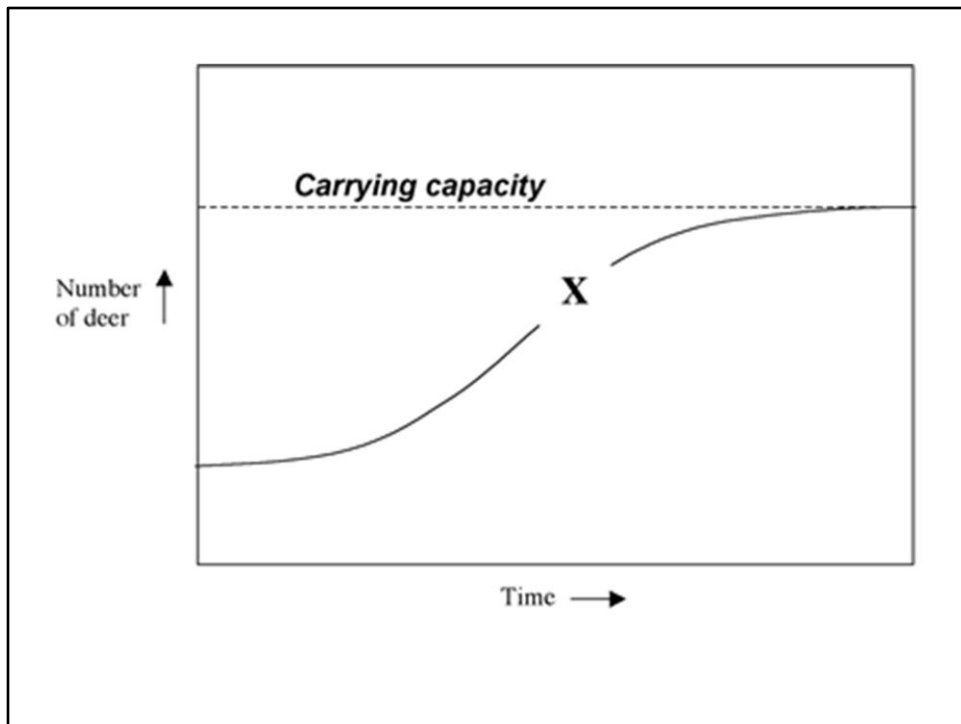
- Habitat for males and non-reproducing females during summer
- Habitat for all deer during winter

A much finer scale and more important way of categorizing habitat is in terms of the two functions we used in our definition of habitat: reproduction and maintenance. It may roughly correspond to our seasonal ranges with some very important distinctions: 1) not all of designated summer range is reproductive habitat (in fact maybe only a small portion), and 2) some of winter range (small patches) also serve as reproductive habitat. As we'll see in a minute, reproductive habitat is extremely important and is often a limiting factor in mule deer populations.

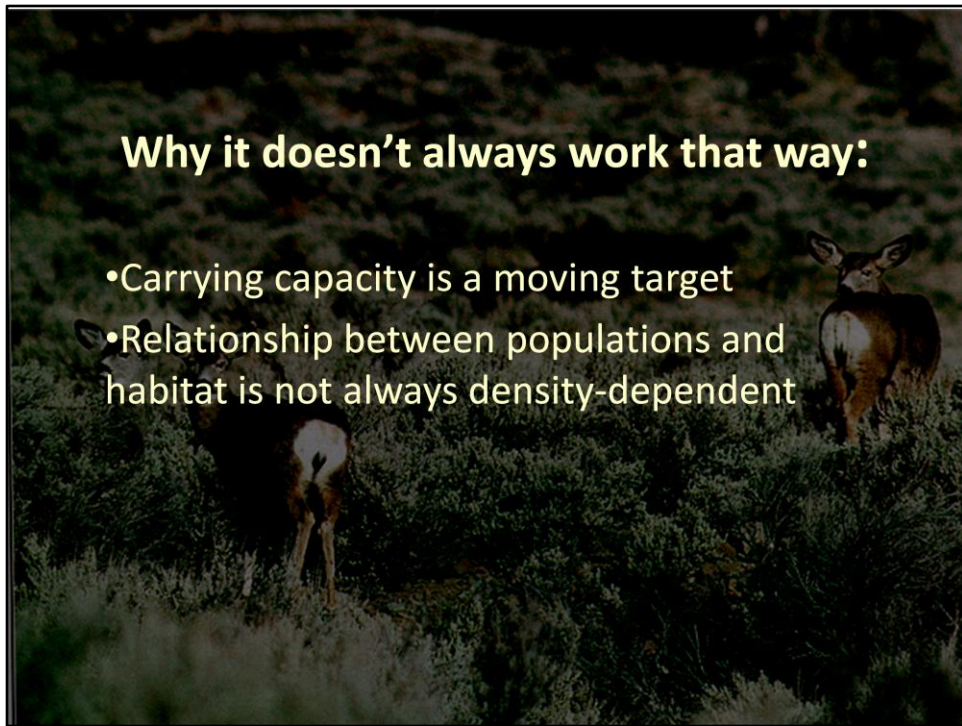
Relationship between mule deer numbers and habitat

- Carrying capacity
- The number of animals a range supports at equilibrium
- Amount of food \longleftrightarrow numbers of deer

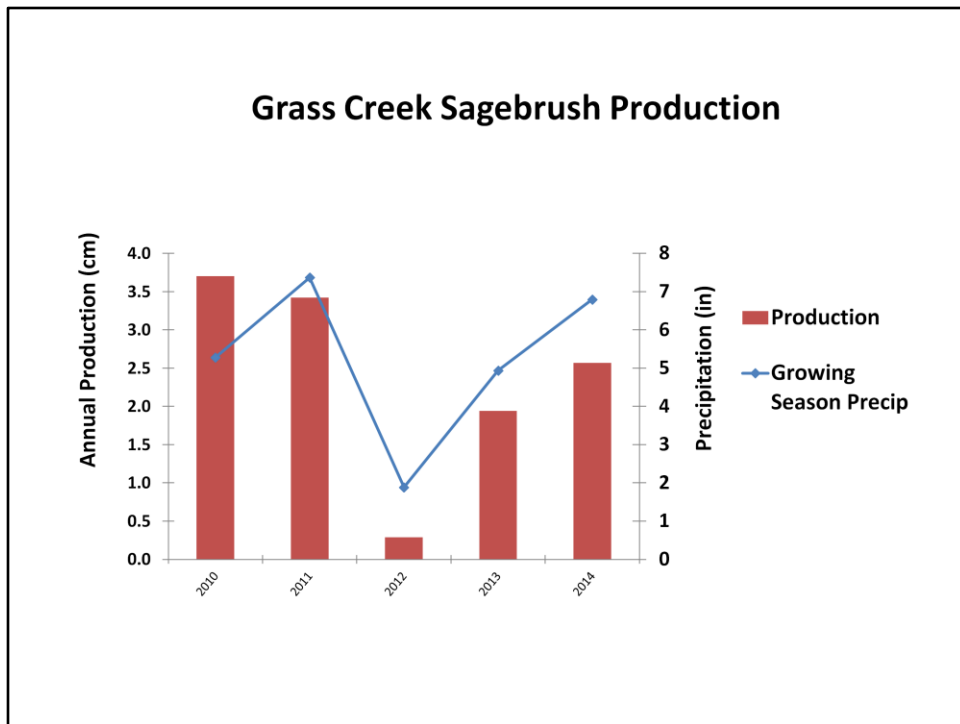
Now let's look at populations and the relationship to habitat. Traditionally wildlife managers have focused on something called a "density dependent model" which explains population/habitat relationships in terms of density of animals and resulting competition for resources, particularly the quantity of food. The hypothetical population level that a range is capable of supporting before this competition limits population growth to zero is called carrying capacity.



This graph illustrates carrying capacity. As a population grows and individuals began to compete for limited resources (again, usually food and particularly on winter range), vital rates such as birth rates and juvenile and adult survival began to decline. Eventually the number of young recruited to the population equals the number of adults that die each year and the population “flat lines” at the “carrying capacity”. The most productive stage from a standpoint of the number of bucks recruited into the population is indicated by the “X” (somewhere below carrying capacity). A population that “overshoots” carrying capacity can cause long-term damage to habitat by overuse of plants.

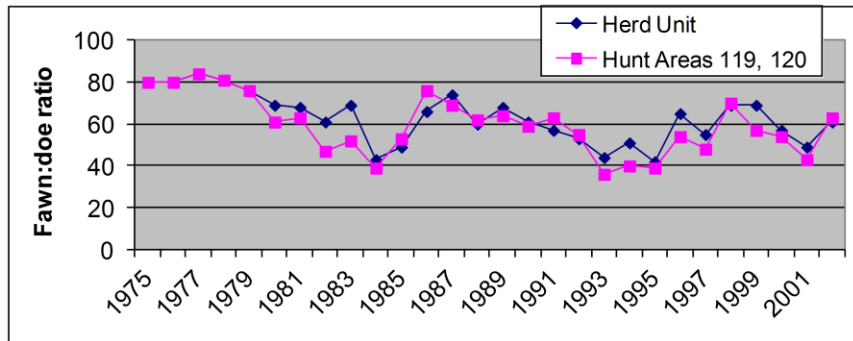


While the “density dependent model” and carrying capacity work well in lab or textbook, it rarely works like this in a real mule deer population.



This graph shows sagebrush production (average length of twig that grew in each year) for the last five years at one of our production/utilization transects in the OCM herd unit. The production of sagebrush and other forage plants are directly correlated with how much precipitation is received during the growing season (April-June). The amount of food in the form of sagebrush available in 2012 was only about 1/15th that available in 2010, which means that the carrying capacity on winter range was reduced by that much. Carrying capacity is a moving target!

Density dependent?



This graph shows fawn ratios from classifications done in December (an indicator of herd productivity) over a period of time when the total population declined. Does it have anything to do with deer densities? It could if carrying capacity is much lower now than it was in 1975 and deer are less productive because they are at or above that new carrying capacity. But it is also likely that deer are responding to annual habitat conditions that effect individual deer regardless of total numbers of deer in the herd unit. In other words, it may not be density-dependent, but density independent. For example, if drought conditions affect plant nutrition in a way that, even if a deer is not competing with another deer to fill her stomach full of food, the food she is getting doesn't meet her nutritional requirements, it doesn't matter if there are 500 or 5 deer per square mile—she will do poorly.



Owl Creek/Meeteetse Mule Deer Habitat Evaluation Project

- Re-read range trend studies
- Evaluated shrub condition
- Compiled disturbance history
- Repeated old photographs
- Determined food habits
- Analyzed climate data

In the 2001 and 2002 we conducted a habitat evaluation study in the OCM herd unit to determine factors that may be contributing to low deer numbers. We relocated old (established 1960's through early 1980's) range trend transects and re-read them to determine trend in range condition. We established shrub transects to evaluate annual and long-term condition including production, utilization, age and protein content. We compiled records of sagebrush sprays and fires (both prescribed and wildfire), two of the most significant actions that disturb mule deer habitat. We found old landscape photographs and re-took the photographs to visually document changes shrub and tree cover. We collected deer fecal samples in spring, summer and winter to determine what kinds of plants were in their diets. Finally, we analyzed climate data (growing season and annual precipitation) compared to herd productivity (fawn ratios) to determine correlations.

**Summarization of vegetative changes on permanent plot
transect trend studies within mule deer transitional range**

	Number of Transects		
	Positive Change	Negative Change	Static or Inconclusive
Trend in Range Condition	2	2	1
Production of grass	0	4	1
Occurrence of Desirable Forbs	4	0	1
Forb Diversity	4	1	0
Production of forbs	4	1	0
Occurances of Big Sagebrush	0	4	1
Canopy Cover of Big Sagebrush	1	2	2

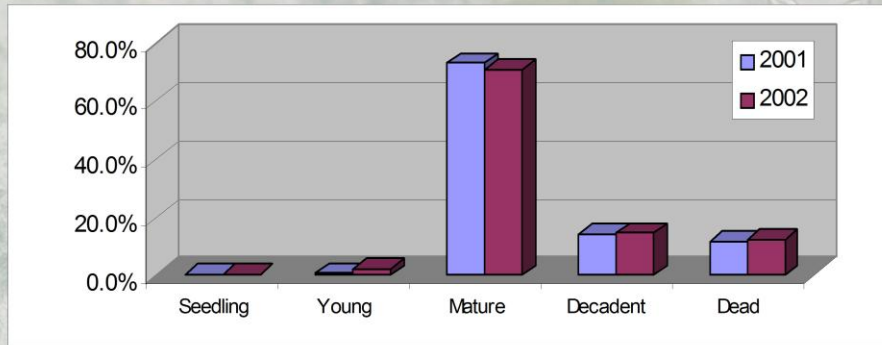
This table shows the trend on 5 range trend transects located on mule deer “transitional” ranges (typically used in spring and fall). Positive and negative change means and increase or decrease in whatever is being measured. Both forb diversity (the number of different kinds of forbs) and total production of forbs increase from when these transects were established in the 70’s and early 80’s, indicating a beneficial change for mule deer. Sagebrush cover was reduced at these transect sites (a negative change), mostly because of prescribed burns

Summarization of vegetative changes on permanent plot transect trend studies within mule deer winter range

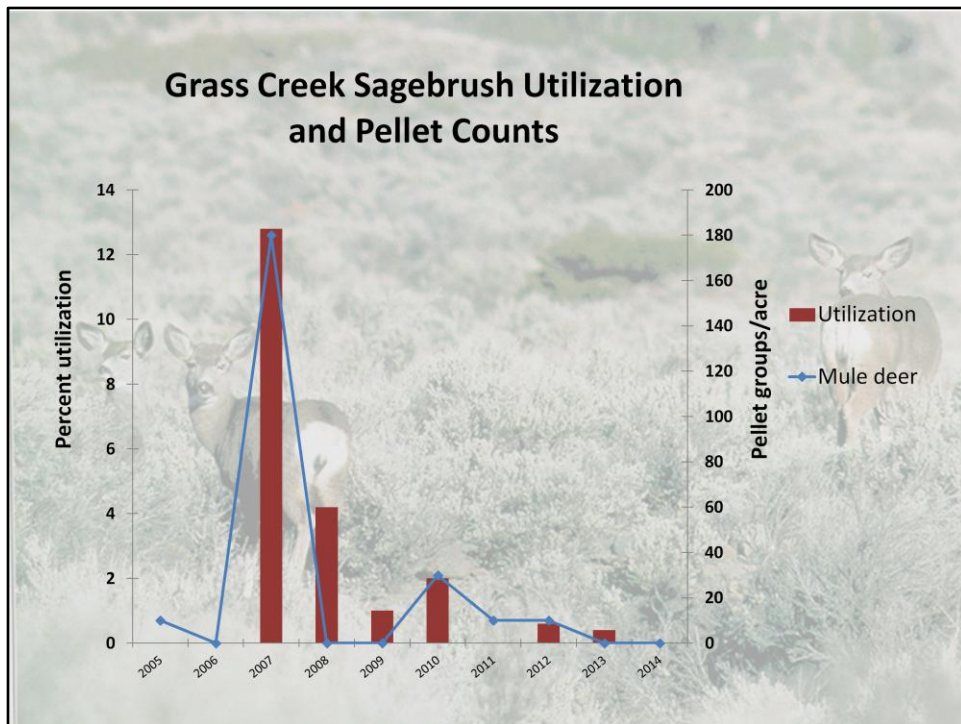
	Number of Transects		
	Positive Change	Negative Change	Static or Inconclusive
Trend in Range Condition	2	13	3
Production of grass	1	12	5
Occurrence of Desirable Forbs	7	7	4
Forb Diversity	2	14	2
Production of forbs	3	14	1
Occurrence of Big Sagebrush	3	4	11
Canopy Cover of Big Sagebrush	3	4	11

Transects on winter range showed an overall decreasing trend in range condition with a marked reduction in forbs. Both of these trends may be partly due to the extreme drought conditions that existed when these were re-read. Range condition, while an indicator of overall health of rangelands, does not necessarily relate to deer habitat. There is some evidence that excellent range conditions are not optimum mule deer habitat. Although these transects do not show a significant trend in brush occurrence or cover, a comparison of photos from older trend studies (late 60's and early 70's) indicate an increase in both age and cover of sagebrush at most (the data collected at these "3'X3' studies is of limited value because of the small sample).

Average age structure of sagebrush plants in 18 transects.

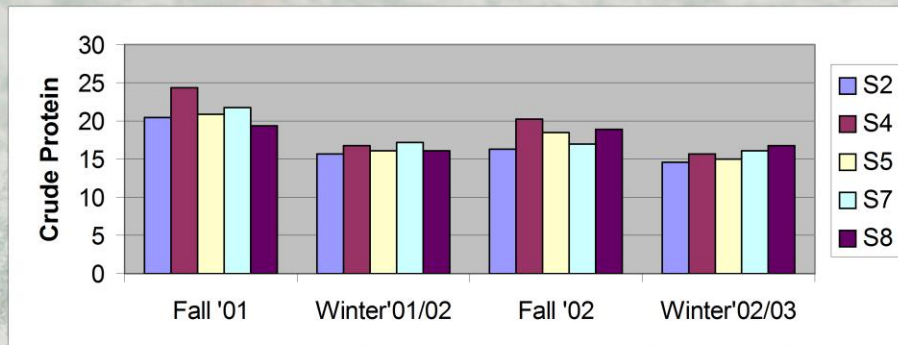


The age of sagebrush plants sampled during this study indicates plants that are probably older than is normal in healthy sagebrush communities. There is a relatively high proportion of decadent and dead plants. This may in part be due to the extreme drought conditions prior to this study.



Utilization of sagebrush throughout the study area was and has remained very light, indicating that quantity of winter food is not a limiting factor.

Crude protein levels for Wyoming big sagebrush at 5 transect locations.



Allot. #	Allot. Name	Average Actual Use 1976-1980 (Public AUM's)	Average Actual Use 1987-1991 (Public AUM's)	Average Actual Use 1998-2002 (Public AUM's)
02510	Gould Individual	347	249	316
0516	Blue Creek	199	11	149
0524	Cottonwood	285	131	114
0545	Grass Point	637	372	450
0564	Little Buffalo Basin	561	282	368
0596	Wagonhound	1237	477	741
0620	Prospect	1249	703	571
0633	Upper Pastures	1180	1225	798
0634	Lower Pastures	1997	1172	575
0678	South Grass Creek	1248	923	1166
Total		8940	5545	5248

Actual livestock use has decreased in the area since the late 70's. There is some speculation that heavy livestock grazing that occurred in the first half of the 20th century may have caused habitat changes that were, at least in the short term, beneficial for deer.

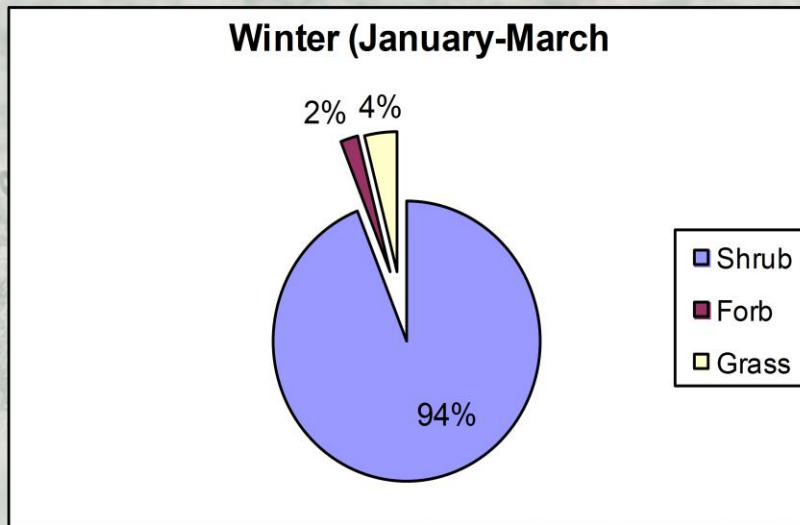
Years	Acres by Disturbance Type				
	Wildfire	Prescribed Fire	2,4-D Herbicide	Tebuthiuron Herbicide	Total
1960-1969	0	0	23,558	0	23,558
1970-1979	0	0	0	0	0
1980-1989	554	1536	0	0	2,090
1990-1999	519	22,290	0	532	23,341
2000-2002	18,850	2,027	0	0	20,877
Total	19,923	25,853	23,558	532	69,866

Mule deer thrive in habitat with some disturbance that keeps portions of there range in younger successional stage. This table indicates that few disturbances occurred in the 70's and 80's, which may have had a negative impact on deer.



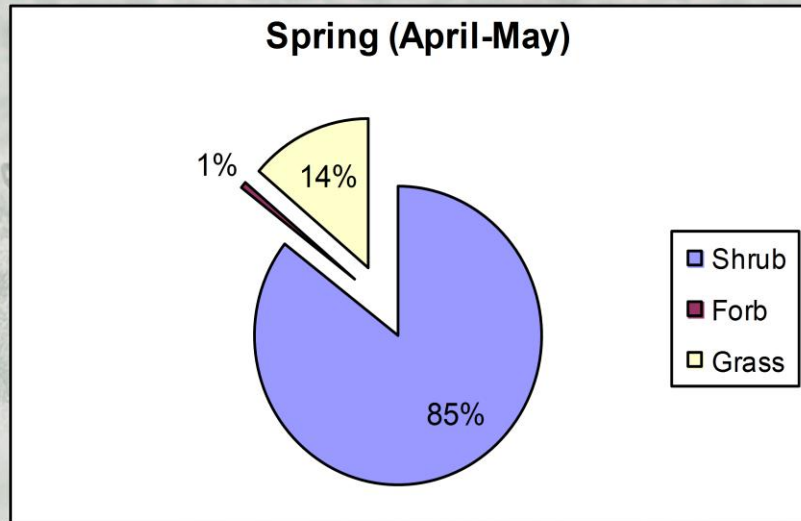
Nearly all of the repeat photos showed an increase in conifer encroachment into sagebrush communities in the last 40 years. These two series (top photos taken in 1963 and bottom in 2003) show an increase in limber pine in Grass Creek.

Percentage of forage classes consumed by mule deer by season as determined by microhistological analysis.

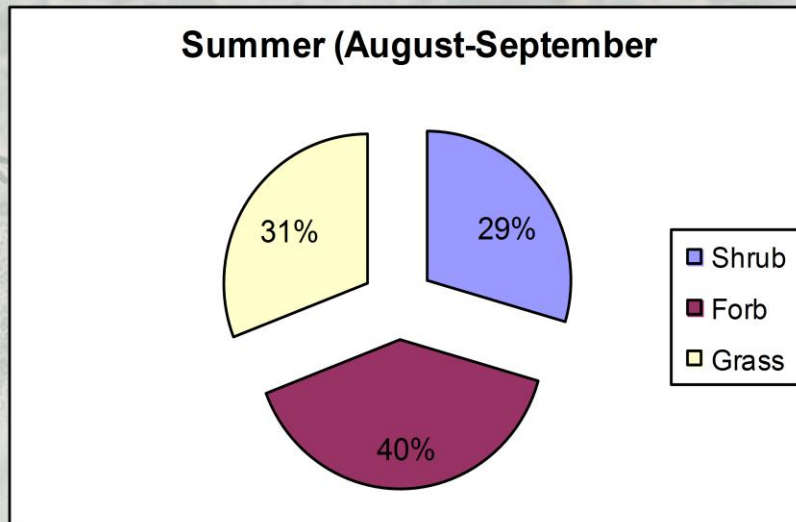


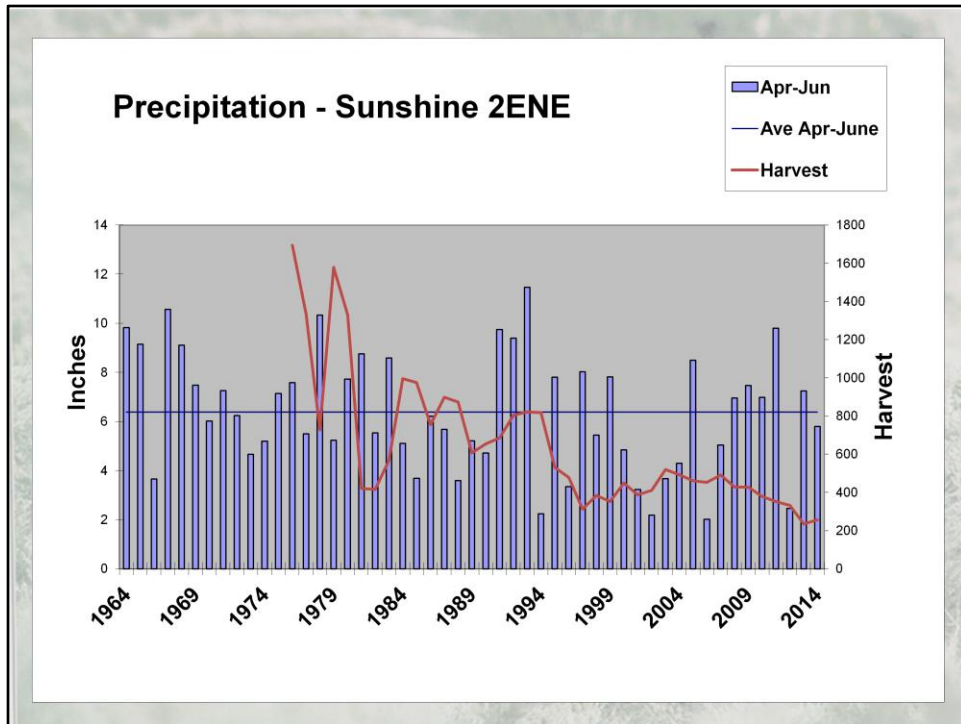
Food habits of deer in this herd unit did not differ from other food habit studies in similar habitats in the west. The types plants eaten show a pattern of deer selecting different plants (forbs grasses and shrubs) in response to changing nutritional status of these plants in different seasons.

Percentage of forage classes consumed by mule deer by season as determined by microhistological analysis.



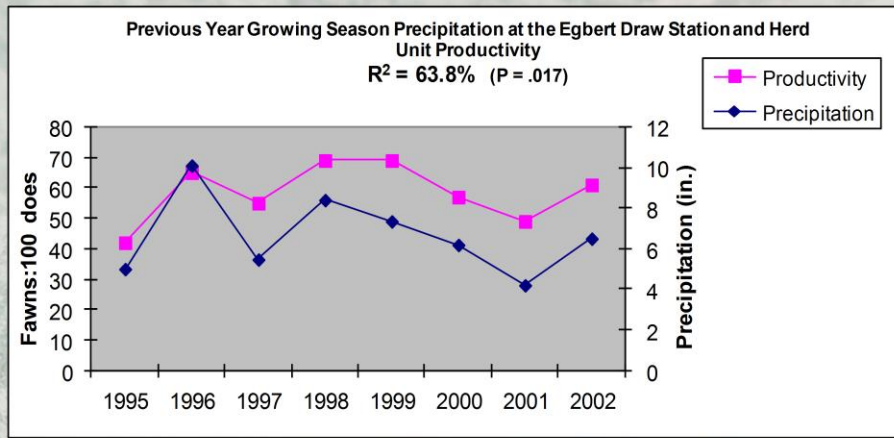
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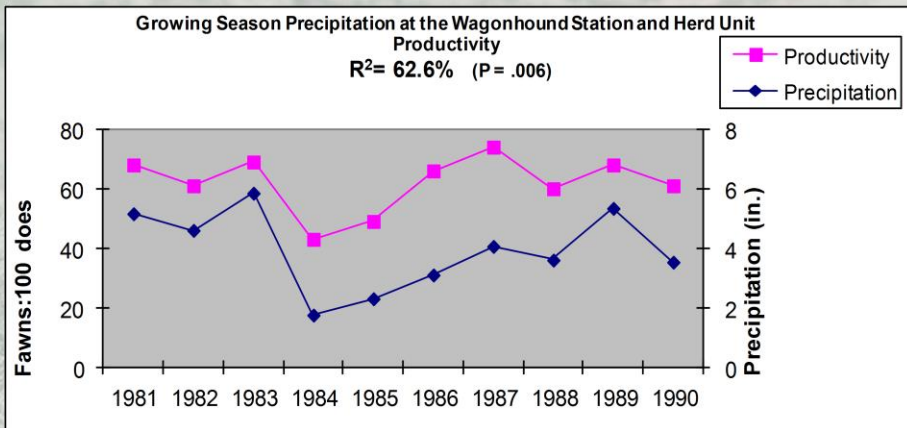
This graph shows growing season precipitation from a NOAA weather station near Upper Sunshine Reservoir. The flat blue line is the average over this time period. Note the declining trend in moisture. The total harvest of mule deer (red line), which is an indicator of total population, has followed this trend. Mule deer numbers in the arid west are very much tied to precipitation.

Series of precipitation and productivity data exhibiting a good fit.



The next two slides show precipitation from two weather stations in the herd unit area graphed alongside fawn:doe ratios as counted in the December. The correlation was very high.

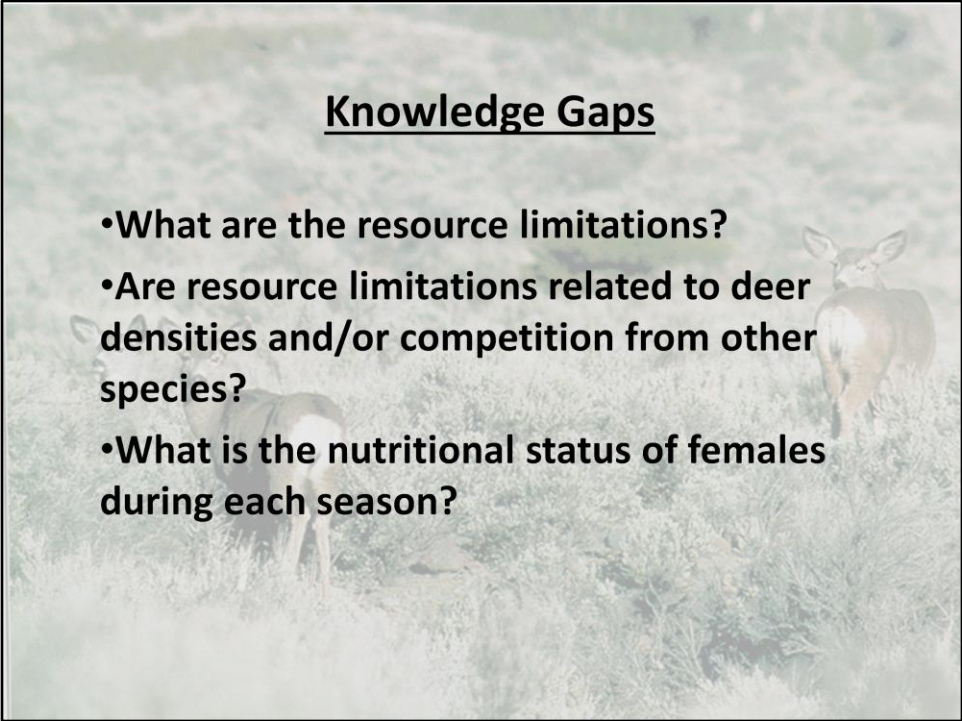
Series of precipitation and productivity data exhibiting a good fit.



General summary

- Conifers are encroaching into sagebrush habitats
- Sagebrush density has increased with probably older age classes
- Rain grows deer

A few take home points from this study



Knowledge Gaps

- What are the resource limitations?
- Are resource limitations related to deer densities and/or competition from other species?
- What is the nutritional status of females during each season?

These knowledge gaps are critical address if we are going to make good decisions about mule deer management including habitat management. Unless we know what is limiting mule deer numbers, we can't be certain we are taking the right steps to address the issue.